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ABSTRACT

Political Economy of Infrastructure Investment Allocation: Evidence from a Panel of Large German Cities

by Achim Kemmerling and Andreas Stephan

This paper proposes a simultaneous-equation approach to the estimation of the contribution of infrastructure accumulation to private production. A political-economy model for the allocation of public infrastructure investment grants is formulated. Our empirical findings, using a panel of large German cities for the years 1980, 1986, and 1988, suggest that cities ruled by a council sharing the State ('Bundesland') government's current political affiliation were particularly successful in attracting infrastructure investment grants. With regard to the contribution of infrastructure accumulation to growth, we find that public capital is a significant factor for private production. Moreover, at least for the sample studied, we find that simultaneity between output and public capital is weak; thus, feedback effects from output to infrastructure are negligible.

ZUSAMMENFASSUNG

Politische Ökonomie der Allokation von Infrastrukturinvestitionen: Empirische Evidenz von einem Paneldatensatz großer deutscher Städte

Dieses Papier verwendet ein simultanes Gleichungssystem zur Schätzung des Beitrags von Infrastrukturinvestitionen zu regionalem Wachstum. Ein polit-ökonomisches Modell der Allokation von Finanzzuweisungen für öffentliche Investitionen in Infrastruktur wird formuliert. Unsere empirischen Ergebnisse basierend auf einem Paneldatensatz für große deutsche Städte in den Jahren 1980, 1986 und 1988 deuten darauf hin, dass Städte, deren Mehrheit im Stadtrat die selbe politische „Couleur“ wie die Landesregierung hatte, erfolgreicher bei der Zuteilung von Finanzzuweisungen waren. Im Hinblick auf den Beitrag der Infrastrukturakkumulation auf das Wachstum finden wir, dass öffentliches Kapital ein wichtiger Faktor für die private Produktion ist. Weiterhin, zumindest für den untersuchten Zeitraum, finden wir, dass die Simultanität zwischen Output und öffentlichem Kapital gering ist; daher sind Feedback-Effekte von Output zur Infrastruktur vernachlässigbar.

1. Introduction

This paper examines the role of public capital in private production and provides a political-economy model of the allocation of public infrastructure investment grants. From this perspective, our study links the literature on the productivity effects of infrastructure with the literature on the political-economy of policy-making.

Since Aschauer published an influential series of papers (1988, 1989a, 1989b, 1989c) about the effects of public infrastructure investment for long-run growth and productivity in the U. S. and other major countries, there has been an ongoing debate about the role of public infrastructure in generating national welfare. Aschauer (1989a), for example, using a production function approach with aggregate time-series data for the U. S. from 1949 to 1985, found that the elasticity of output with respect to a broad measure of public infrastructure was significant and of a remarkable magnitude. At a time of widespread concern about the slowdown of U. S. productivity growth in the 1970's and 1980's this finding suggested that the general decline in public infrastructure spending in the U. S. since the 1970's could at least partly explain the observed slowdown in productivity growth.

However, the magnitude of the estimated elasticity of infrastructure capital in Aschauer (1989a, 1989b, 1995) and other studies (Garcia-Mila and McGuire, 1992; Munnell, 1990a; Munnell, 1990b; Munnell, 1992; Munnell, 1993) is still a matter of discussion. The main focus of the so-called 'infrastructure' debate is on the interpretation of results and on the appropriate empirical methodology (Aaron, 1990; Gramlich, 1994; Holtz-Eakin, 1994). For example, it is argued that the direction of causation is unclear, i.e., whether causality runs from infrastructure to growth or from growth to infrastructure (Tatom, 1991; Tatom, 1993). In order to address the problem of causality econometrically several studies have suggested simultaneous-equation-approaches with public infrastructure investment as an endogenous variable (e.g., Cadot et al., 1999; Duffy-Deno and Eberts, 1991; de Frutos and Pereira, 1993).

In this paper we adopt the simultaneous equation approach of Cadot et al. (1999). This not only allows us to address the issue of endogeneity of infrastructure investments, but also to test whether the German case gives comparable results to the French 'pork-barrel politics' of investment decisions or whether the peculiarities of the political system in Germany make a different way of political decisions about the allocation of public infrastructure investments more plausible.

Previous studies on the role of fiscal federalism for infrastructure policy have mainly focussed on optimal rules for the provision of infrastructure at different levels of government (e.g., Hulten and Schwab, 1997). However, it remains an open question whether infrastructure policies are in reality designed according to such efficiency considerations. Therefore, the main contribution of our paper is that we empirically shed light on other potential determinants of infrastructure policies. What we suppose to be other potential determinants of infrastructure policy are (i) 'pork-barrel' politics due to the influence of firms on the allocation of investments or (ii) distortions in allocation due to the political affiliation of governments at different levels. These influences may give rise to results that might depart substantially from optimal allocation as a result of maximizing social welfare.

In Cadot et al. (1999) a political-economy model is applied to explain the regional allocation of public infrastructure investment. Here, we use a similar model. One difference is, however, that the study by Cadot et al. (1999) focusses on the allocation of infrastructure investment at the regional level in France, whereas our study examines the allocation of infrastructure investment grants at the level of large German cities. Specifically, we derive an econometric model from a 'menu auction game' that was originally developed by Bernheim and Whinston (1986a, 1986b) and has also been applied by Grossman and Helpman (1994). This model is based on a very general framework for political-economy analysis which views economic policy decisions as being a result of the maximization of objective functions by incumbent politicians under constraints that are primarily political (see also Dixit, 1996).

Cadot et al. (1999) test their model using a panel data set of French regions and find a significant relationship between the number of large firms in a region as an indicator of lobbying strength and the infrastructure investment allocation. Moreover, they also find that political affiliation plays an important role in channelling public infrastructure towards regions that share the same 'colour of government'. The results of Cadot et al. (1999) are perfectly comparable with the political science literature referring to the French system of decision-making (Frere, 1998). High centralization and top-down administration – leaving comparatively little space for local autonomy – make this system particularly vulnerable to lobbying by large firms.

In contrast, as a result of federalism the German decision making system is deeply nested and intertwined. The spheres of competence and control as well as the financing of investment are not as separated as it is in the case of France or the U. S. but they are overlapping and mutually dependent (Scharpf, 1988). This makes an extension of the basic model inevitable.

Investment in municipal infrastructure usually consists of two parts: autonomous investment and investment grants. Whereas the former is a matter of decision for municipal councils the latter is predominantly provided by the federal States ('Bundesländer'). Because of the increasing role of investment grants since the 1970's we assume that these financial resources are heavily contested among manufacturing firms. With fiscal federalism diluting political accountability and channels of interest management, these firms might find it difficult to divert infrastructure investment to their regions. This is a result of what we call the logic of 'intertwined politics'. A possible exception might exist if local council members could short-cut the bargaining process by means of vertical political alignments.

With our empirical model we can test these two ideas – pork-barrel vs. intertwined politics – on a panel data set consisting of 91 German cities for the years 1980, 1986 and 1988. As in Cadot et al. (1999) we use a simultaneous-equations approach to estimate the relationship between infrastructure investments, output, policy and lobbying variables. One of our main findings is that political affiliation, measured by the coincidence of party colour between state and local government, is decisive in explaining the distribution of investment grants.

The remainder of this paper is organized as follows: In section 2, we discuss the political lobbying framework, which Cadot et al. (1999) applied to the regional allocation of infrastructure investments in France. In this section, we also deal explicitly with two peculiarities of the German case in comparison to France:

investment grant policy and fiscal federalism. Section 3 motivates our model of the allocation of infrastructure investment grants across cities. In section 4 we describe the panel data used in the analysis and present the results of our empirical estimations. Section 5 provides conclusions.

2. Modelling endogenous infrastructure investment decisions in Germany

2.1. The original framework of political lobbying for infrastructure investment

In Cadot et al. (1999) a political-economy model is applied to explain the regional allocation of public infrastructure investment. This model is based on a general framework for political-economy analysis that views economic policy decisions as a result of the maximization of objective functions by incumbent politicians under constraints that are primarily political.

The starting point of this framework is the assumption that firms offer campaign contributions to incumbent politicians in return for additional spending. These contributions reflect the firms' marginal willingness to pay for additional infrastructure. Therefore, they reflect infrastructure's marginal contribution to firm value, both on the supply side, through the infrastructure's contribution to productivity in all sectors, and on the demand side for the construction industry itself.

In the context of infrastructure investment the motivation for lobbying is the following: Firms have vested interests in the quality of the infrastructure in those municipalities where they have high sunk investment, which is usually the location of production. The authors argue that large firms will lobby harder because these firms produce, on average, for more distant markets and therefore use public infrastructure more intensively than others. Moreover, large firms have two strategic advantages. They are able to overcome problems of collective action more easily than small enterprises and their form of lobbying – personal contacts between big business and high politics – may be more efficient than the lobbying activities of small firms.

The underlying model of the political decision making system is quite simple: Local politicians act as contribution collectors, providing their affiliated parties' headquarters with locally generated campaign contributions. Furthermore, local politicians propose public infrastructure projects – on behalf of the voters – that are approved by central government. In contrast to Grossman and Helpman (1994), Cadot et al. (1999) thus allow for two different levels in the decision making process of infrastructure policy. Pointing to the high level of centralization the authors argue that the basic model holds for the French case. Therefore, there is no principal agent problem between local and central policy makers.

However, the assumption of a simple representative democracy, where all decisions are made at the highest government level and than implemented by obedient lower administrative officials is not valid for the German federal system as a broad array of studies show (Garlichs, 1986; Scharpf, 1988; Scharpf, 1999). Therefore, we will have to look with greater accuracy at the way German infrastructure investment is financed.

2.2. The significance of German investment grant policy

Infrastructure investment projects in Germany are usually financed from the resources of two or more levels of governments. Here, we consider two different financial sources for infrastructure investment: autonomous investment by municipalities and investment grants[1] provided by other institutions, e.g. the central government ('Bund'), the federal States ('Bundesländer') the European Recovery Program (ERP) or horizontal fiscal exchange mechanisms. In our context the 'Bundesländer' are of particular interest because they provide the major part of these grants (Pohlan, 1997). The procedure for starting a new infrastructure investment project is a complex arrangement between the local government, which makes a proposal in the first stage of project planning, and the 'Länder' or 'Bund' administration that grants an investment subsidy. Because of the growing fiscal tension in the local budgets (Pohlan, 1997), the role of investment subsidies has risen through the 1980's. In 1980 the ratio between investment subsidies from 'Bund', 'Bundesländer' and the ERP to total investment in road infrastructure was about 24 percent, whereas in 1988 this ratio rose to 46 percent. The municipalities' dependency on investment grants also makes it difficult for them to plan investment projects autonomously. One reason for this is the overall increase of insecurity in the planning process, as local decision makers cannot anticipate the correct amount of future transfer payments (Bundesamt, 1986: 913).

Second, mixed financing of infrastructure projects undermines local political autonomy. An example may illustrate this point: Schmals (1982) cites a case study about public transportation in Munich at the end of the 1970's. Two alternative plans to improve public transport existed. The first plan proposed the construction of a network of underground railways to alleviate inner-city traffic. The majority of city council members favoured this project. The second proposal, the construction and improvement of a municipal railway system, was backed by the Bavarian government. Because the Bavarian 'Bundesland' linked an investment grant to the realization of the second project, the city council had to give in. Thus, in this case investment grant prospects had a decisive impact on the bargaining power between the two governmental levels.

The amount of investment subsidies granted to local infrastructure projects formally depends on such external factors as car density, length of the road network, etc. But as Garlichs (1986) shows in the case of infrastructure funds for highways, the actual amount of money is a matter of intense bargaining between lower level governments and the higher level. As for highways, the authorities involved are the 'Bund' and the 'Bundesländer' governments. But this also applies in the case of local infrastructure projects (Garlichs, 1986: 136). Frequently, the result of the bargaining process is a quota system that reflects the traditional or even legally settled principle of unanimity.

The increasing importance of investment grants for the realization of investment projects led us to model both sources (grants and autonomous investment) separately in our simultaneous equation approach (see section 3 below). In order to describe this simultaneous determination properly, our model has two equations: one which describes the autonomous investment decisions of the cities and one which describes the level of investment grants the cities receive from higher level governments. Furthermore, autonomous investment enters the grants equation and vice versa.

From this model it is also possible to answer the question of whether the relationship of autonomous investments and investment grants is complementary, substitutional or neutral. But the existence of two mutually dependent levels of government that both intervene in the decision making process of infrastructure policy has even broader implications for the lobbying framework.

2.3. Infrastructure policy and the 'logic of intertwined politics' in Germany

The underlying assumption of a simple (Westminster) representative democracy seems to be severely violated in the German case. One of the reasons for this is the peculiar nature of German federalism which has been characterized in literature as a 'unitary federal state' ('Verbundföderalismus' or 'föderativer Bundesstaat').

In Germany, spheres of competence and control, as well as the financing of investment, are not as separated as for example in the case of U. S. federalism. Rather it is overlapping and mutually dependent. Therefore, although the states ('Bundesländer') and the municipalities ('Kommunen') are exclusively responsible for the main part of public infrastructure in a formal sense, investment decisions also depend on the amount of public subsidies which come from either the federal state, the federal states or from the European Union.

Moreover, German federalism is constitutionally obliged to balance local autonomy and the uniformity of living conditions throughout German territory. Humplick and Moini-Araghi (1996) show that this often results in a less efficient provision of public infrastructure. Germany has a high standard of road infrastructure but its construction costs are higher than in other OECD countries. As Humplick and Moini-Araghi (1996: 32) put it 'the equity objective overrides the efficiency objective'. These obligations in German federalism create the need for a network of horizontal and vertical bargaining institutions that coordinate the interests of the several governmental levels.

In our case it is difficult to specify the exact locus of decision making power for road infrastructure investment. Abstracting from the federal state or relationships with the E. U. , we have two important levels in the German political system, each with its own interests: 'Bundesländer' and local governments. 'Bundesländer' governments want – among other things – to maximize the welfare of their territory and try to balance diverging regional developments. The local governments try to get as many investment grants as possible (pork-barrel politics). Both levels are forced to bargain as the 'Bundesländer' government wants to intervene but lacks information about where to do so whereas the local governments compete with each other for scarce resources.

This phenomenon is easily visible in all policy areas that bind different German government levels together, and it is often cited as 'intertwined politics' ('Politikverflechtung'). In our context it describes the pathological situation when municipalities and the States lack the autonomy to make their own decisions, whereas the 'Bundesland' simultaneously lacks information to control the other governmental levels, so that neither of the two governmental levels is able (and inclined) to provide investment allocation efficiently. Moreover, political accountability is diluted because there is no single agent that bears all the responsibility for a single policy. There are many studies that show the negative effects of 'intertwined politics' in Germany (Scharpf et al., 1976; Scharpf, 1988; Scharpf, 1999)

This might produce perilous effects for pluralistic lobbying such as in U.S. interest mediation: a complex and closed system of decision making could be a serious problem even for powerful lobbies.[2] In other words, large firms will find it extremely difficult to divert infrastructure investments to their region if there is no way of short-cutting the bargaining process by means of vertical political alignments.

In our political-economy framework we are especially interested in political variables that influence the allocation of investment subsidies. We argue that because of the complex federal system as described above by the notion of 'intertwined politics' those local governments whose political 'colour' corresponds to that of the 'Länder'-government get more investment subsidies, because this lowers the transaction costs of information transmission between governments. The identity of political colour shortcuts this bargaining process and favours certain municipalities by means of party loyalty.

Whether German infrastructure policy follows the logic of the lobbying framework, that of 'intertwined politics' or both is the fundamental question for the empirical estimation. But let us first summarize the structure of our model with the whole set of hypotheses.

3. Structure of the model

Our model is based on 3 equations, which we label as (i) production function, (ii) city i's lobbying function and (iii) city i's infrastructure investment function.

3.1. Production function

To begin with, we assume that the production Q_{it} of the manufacturing sector can be described as

$$Q_{it} = f(t, K_{it}, L_{it}, G_{it}), \qquad i = 1 \dots N, \qquad t = 1 \dots T, \tag{1}$$

where t denotes time, Q_{it} output, K_{it} private capital, L_{it} labour input and G_{it} denotes the infrastructure stock in city i. In addition, city i's infrastructure stock G_{it} is defined as

$$G_{it} = (1-\gamma)G_{i,t-1} + INV_{it} + GRANTS_{it}, \tag{2}$$

where γ denotes the depreciation rate of public capital, INV_{it} denotes infrastructure investment, and $GRANT_{it}$ denotes infrastructure investment grants given to city i from the State ('Bundesland') government. Therefore, total infrastructure investment in city i is defined as $INV_{it} + GRANT_{it}$.

Assuming a Cobb-Douglas functional form for the manufacturing sector's production function in city i at time t we get

$$Q_{it} = A_0 \exp(\alpha_t t)\, L_{it}^{\alpha_L} K_{it}^{\alpha_K} G_{it}^{\alpha_G}, \tag{3}$$

where α_X denotes the elasticity of output Q with respect to input X, and $X \in \{t, L, K, G\}$. Dividing by L_{it}, (3) becomes

$$q_{it} = A_0 \exp(\alpha_t t)\, k_{it}^{\alpha_K} g_{it}^{\alpha_G} L_{it}^{\tilde{\alpha}_L}, \tag{4}$$

where small capitals denote variables in terms of the labour input L and $\tilde{\alpha}_L$ is defined as $\tilde{\alpha}_L = \alpha_L + \alpha_K + \alpha_G - 1$.

Note that $\tilde{\alpha}_L$ will equal zero if returns to scale are constant with respect to *all* inputs, i.e., L, K and G; and $\tilde{\alpha}_L - \alpha_G$ will equal zero if returns to scale are constant with respect to private inputs L and K.

3.2. CITY i'S LOBBYING FUNCTION

City i's lobbying function for state investment grants can be described as follows

$$GRANT_{it} = f(Q_{it}, INV_{it}, \textbf{policy variables}, \textbf{lobbying variables}). \tag{5}$$

Thus, we assume that $GRANT_{it}$ depends on investment decisions, i.e., INV_{it}, but also on a set of *policy*, '*lobbying*' and other (exogenous) variables. For instance, we expect that a city will receive more grants if it has a lower initial income, or a lower growth of Q_{it} in a previous period relative to other cities. Subsequently, the 'Bundesland' government will use its investment grant policy to promote growth in 'poorer' cities. On the other hand, we assume that firms in the manufacturing sector have sunk investment giving them vested interests in the quality of infrastructure in cities where they have establishments and production units. The reason is that firms of the manufacturing sector quite often produce for more distant markets than for example firms of the *service* sector. Therefore, firms in the manufacturing sector in a given city should be expected to lobby harder than other firms for the maintenance and upgrading of that city's infrastructure.

The form of lobbying we suppose is fairly simple. Firms offer campaign contribution to local politicians in return for additional infrastructure spending. Local politicians act as campaign contribution collectors, final decisions about infrastructure investment grants are made at the state ('Bundesland') level.

The lobbying game can be motivated as follows. Following Bernheim and Whinston (1986a), and Grossman and Helpman (1994), lobbying activities are modelled as a 'menu' auction, whereby several lobbies bid non-cooperatively for influence over a policy variable determined by an auctioneer, in our case the 'Bundesland' government. The main difference between a menu and a standard auction is, that in the former bids are functions and not just a non-negative real number as in the standard auction and all players end up paying something, whereas in the standard auction only the winner pays.

To formalize this idea, let us assume that there is a set L of principals (lobbies), in our case the councils of large cities. The auctioneer, in our case the 'Bundesland' government, may choose an allocation of public investment grant allocations $\mathbf{grant}_t = (grant_{1t}, ..., grant_{nt})$ from a set $\mathfrak{X}$. The set $\mathfrak{X}$ is bounded so that each investment grant policy $grant_i$ must lie between some minimum $\underline{grant}_i$ and some maximum $\overline{grant}_i$.

In each period, cities indexed by $i = 1, ..., n$ simultaneously face the 'Bundesland' government, if it is of the same political affiliation, with monetary transfer offers $C_{it}(\mathbf{grant}_t)$ conditioned on the vector $\mathbf{grant}_t$. These monetary transfers can be interpreted in our context as campaign contribution from manufacturing firms which have establishments in a given city. Hence, local politicians act as contribution collectors. The 'Bundesland' government then chooses a value $\mathbf{grant}_t^*$ of the policy vector $\mathbf{grant}_t$ that maximizes an objective function $\mathcal{G}[\mathbf{grant}_t, \sum_i C_{it}(\mathbf{grant}_t)]$. Finally, the cities make transfers $C_{it}(\mathbf{grant}_t^*)$ to the 'Bundesland' government as promised.

An equilibrium of this game is a set of contribution functions $\{C_i^\circ(\mathbf{grant})\}$, one for each city, such that each one maximizes the welfare of the city given the schedules set by the other cities and the anticipated political optimization by the 'Bundesland' government, and a vector $\mathbf{grant}^\circ$ that maximizes the government's objective taking the contribution schedules as given (Grossman and Helpman, 1994).

Social welfare will be of concern to the government because voters are more likely to re-elect a government that has established a high standard of living. Suppose the 'Bundesland' governments objective function is given as $\mathcal{G} = \sum_{i \in L} C_i(\mathbf{grant}) + aW(\mathbf{grant})$ with weight $a \geq 0$, and W represents aggregate gross-of-contributions welfare. Thus, the government objective function is given as a weighted sum of campaign contributions and aggregate welfare. Aggregate gross welfare is defined as $W \equiv \sum_{i=1}^{n} w_i(\mathbf{grant})$, where w_i is the level of welfare[3] in city i, and w_i depends on the level of grants with $\partial w_i / \partial grant_i > 0$, $\partial^2 w_i / \partial grant_i^2 < 0$. The equilibrium of this game can be characterized as follows.

LEMMA 1. *(B-W, 1986; G-H, 1994)* $(\{C_i^\circ\}_{i \in L}, \mathbf{grant}^\circ)$ *is a subgame-perfect Nash equilibrium if and only if:*

(a) $C_i^\circ \in \mathfrak{C}_i$ *for all* $i \in L$,

(b) $\mathbf{grant}^\circ$ *maximizes* $\sum_{i\in L} C_i^\circ(\mathbf{grant}) + aW(\mathbf{grant})$ *on* $\mathfrak{X}$,

(c) $\mathbf{grant}^\circ$ *maximizes* $W_j(\mathbf{grant}) - C_j^\circ(\mathbf{grant}) + \sum_{i\in L} C_i^\circ(\mathbf{grant}) + aW(\mathbf{grant})$ *for every* $j \in L$,

(d) for every $j \in L$ *there exists a* $\mathbf{grant}_j \in \mathfrak{X}$ *that maximizes* $\sum_{i\in L} C_j^\circ(\mathbf{grant}) + aW(\mathbf{grant})$ *such that* $C_j^\circ(\mathbf{grant}_j) = 0$.

For a proof of this Lemma see Bernheim and Whinston (1986a), Lemma 2. Condition (a) states that the chosen contribution schedule is among those that are feasible. Condition (b) states, that given the contribution schedules offered by the cities, the government sets its policy to maximize its own welfare. Condition (c) stipulates that for every city i, the equilibrium grant vector must maximize the joint welfare of that city and of the government, given the contribution schedules of the other lobbies. Condition (d) states that there is always an optimal action for each city with zero contribution which the government finds equally attractive as the equilibrium policy vector $\mathbf{grant}^\circ$.

One appealing characteristic of this game, which is of special relevance for our problem of grant allocation, is that in equilibrium players announce their true willingness-to-pay. Thus, a *truthful* payment function for lobby i rewards the government for every change in the action with exactly the amount of change in the lobbies' welfare. This resembles the so-called Groves-Clarke mechanism in the context of bidding for public projects (Clarke, 1971; Groves, 1973).

From this model, we expect that (i) the political affiliation of a city's council, and (ii) the number of manufacturing firms in a given city will affect the level of grants which a city receives.

3.3. City i's infrastructure investment function

Finally, we assume that public investment in city i can be described by the equation

$$INV_{it} = f(Q_{it}, GRANT_{it}, \textbf{policy variables}, \textbf{exogenous factors}). \tag{6}$$

Thus, city i's investment (net of state grants) depend on investment grants but also on a set of policy variables. For instance, if the expected productivity effects of infrastructure in a city are high, the level of investment in this city should be higher compared to cities where expected productivity effects are lower. Furthermore, we expect that the higher the *trade tax* income of a city is, the more infrastructure projects it is able to finance. Similarly, the lower the level of debt that a city has, the more infrastructure projects the city is able to carry out. Finally, we expect that the higher the number of cars in a city, the higher will be the demand for additional road infrastructure projects.

Table I. Variable description and cities

Variable	**Description**
Q	Value added, manufacturing sector, million 1980 DM
L	Hours worked in manufacturing sector, million hours
K	Capital stock in manufacturing, million 1980 DM (from Deitmar, 1993
G	Public infrastructure stock, million 1980 DM, (from Seitz, 1995)
INV	Infrastructure investment, million 1980 DM
$GRANT$	Infrastructure investment grants, million 1980 DM
$DEBT$	Total debt of city, million 1980 DM
TAX	Trade tax ('Gewerbesteuer') income of city i, million 1980 DM
$CARS$	Number of registered cars per capita
$NFIRMS$	Number of manufacturing firms in city i
$DMINING$	Dummy variable equal to 1 when mining industry is present in city i
$PARTISAN$	Percentage of members in city council with the same political affiliation as the government of 'Bundesland'

4. Empirical implementation

4.1. Data

We use a panel data set consisting of 91 German cities and three distinct years. Table 1 provides a brief overview of the variables used in the analysis.

The data is taken from the 'Statistical Yearbook of German Cities and Municipalities',[4] which contains information about 500 German municipalities and

Table II. Cities in panel

Cities in Panel		
1 Aachen	32 Heidelberg	63 Offenbach/Main
2 Amberg	33 Heilbronn	64 Oldenburg
3 Ansbach	34 Herne	65 Osnabrück
4 Aschaffenburg	35 Hof	66 Paderborn*
5 Augsburg	36 Ingolstadt	67 Passau
6 Baden-Baden	37 Kaiserslautern	68 Pforzheim
7 Bamberg	38 Karlsruhe	69 Pirmasens
8 Bayreuth	39 Kassel	70 Recklinghausen*
9 Bielefeld	40 Kaufbeuren	71 Regensburg
10 Bochum	41 Kempten/Allgäu	72 Remscheid
11 Bonn	42 Kiel	73 Rosenheim
12 Bottrop	43 Koblenz	74 Saarbrücken
13 Braunschweig	44 Köln	75 Salzgitter
14 Coburg	45 Krefeld	76 Schwabach
15 Darmstadt	46 Landau/Pfalz	77 Schweinfurt
16 Delmenhorst	47 Landshut	78 Siegen*
17 Dortmund	48 Leverkusen	79 Solingen
18 Duisburg	49 Lübeck	80 Speyer
19 Düsseldorf	50 Ludwigshafen	81 Straubing
20 Erlangen	51 Mainz	82 Stuttgart
21 Essen	52 Mannheim	83 Trier
22 Flensburg	53 Memmingen	84 Ulm
23 Frankenthal/Pfalz	54 Mönchengladbach	85 Weiden/Oberpfalz
24 Frankfurt/Main	55 Mülheim/Ruhr	86 Wiesbaden
25 Freiburg/Berisgau	56 München	87 Wilhelmshaven
26 Fürth	57 Münster/Westfalen	88 Worms
27 Gelsenkirchen	58 Neumünster	89 Wuppertal
28 Göttingen	59 Neuss*	90 Würzburg
29 Hagen	60 Neustadt/Weinstraße	91 Zweibrücken
30 Hamm	61 Nürnberg	

*not included because of missing values for one or more variables

cities. For reasons of comparability we have selected 91 cities that are predominantly self-administered at the local level ('kreisfreie Städte'). This is of special importance as part of our model explicitly deals with the political-economy of these administratively comparable cities. Table 2 displays the names of the cities in the sample. Note that some cities have been excluded from the estimation due to missing values for one or more variables.

Table III. Summary statistics

Variable	Mean	Std.Dev.	C.V.	Minimum	Maximum
Q	2099.1	2500.3	119.1	144.3	15718.8
G	2468.8	2834.5	114.8	302.5	18176.1
K	4087.7	5007.6	122.5	252.0	25714.9
L	30.74	29.08	94.6	2.4	168.2
INV	93.6	123.8	132.3	8.1	1040.4
$GRANT$	32.8	44.7	136.3	0.8	266.1
$DEBT$	407.9	509.1	124.8	14.3	3066.7
TAX	135.6	210.4	155.2	7.1	1314.6
$CARS$	0.459	0.054	11.9	0.347	0.613
$NFIRMS$	124.0	101.1	81.5	21	637
$DMINING$	0.126	0.333	263.4	0	1
$PARTISAN$	45.9	8.0	17.5	29.0	68.2
Total number of observations with non-missing values: 261					

Output (Q), measured as gross value added of a city's manufacturing sector,[5] is taken from a joint publication of several German statistical offices.[6] These data are not available for each year, so we could use only the three years 1980, 1986, and 1988 for our analysis.

The private capital stock (K) of the manufacturing sector is taken from Deitmar (1993). It is given in 1980 prices and has been also carefully corrected for the territorial reforms that occurred in the 1970's in Germany.[7] The infrastructure capital stock (G), which includes investment both for construction and equipments, is taken from Seitz (1994) and is also measured in 1980 prices.[8]

Annual investment in infrastructure (INV) has been obtained from the statistical yearbook mentioned above. From the same source we have also obtained the following variables: labour input (L), operationalized by the number of working hours in the manufacturing sector; special grant-in-aids ('Finanzzuweisungen') for investments ($GRANTS$) from 'Bundesländer', 'Bund' or ERP; several measures of the financial situation of a city like the cumulated debt ($DEBT$) or trade taxes (TAX) which are levied at the local level of cities, the number of four wheel vehicles per 1000 inhabitants ($CARS$), and the number of manufacturing firms ($NFIRMS$) in a city.

Furthermore, we constructed a political variable denoted as $PARTISAN$ to measure the congruence between the local city government and the 'Bundesland' government. It gives the percentage of seats in the city council with the same political affiliation as the 'Bundesland' government where the city is located. Thus, this variable is an indicator of the political 'lobbying' strength of a city relative to the other cities in the same 'Bundesland'.

Table 3 displays some descriptive statistics of the variables. Note, for instance that grants are on average about one-third of autonomous investments. Annual infrastructure investment undertaken by cities is on average about 3.8 percent of the existing infrastructure capital stock. The mining industry is present in about 13 percent of cities in our sample. The partisan variable is on average 45.9 percent, with a minimum of 29.0 and a maximum of 68.2 percent.

As described in the previous section, our model contains the following 3 equations:

Production function

$$\begin{aligned} \ln q_{it} &= \alpha_i + \alpha_t + \alpha_K \ln k_{it} + \alpha_G \ln(g_{i,t-1} + inv_{it} + grant_{it}) + \tilde{\alpha}_L \ln(L_{it}) \\ &\quad + \alpha_{\text{MINING}} DMINING_i + \nu_{1it}, \end{aligned} \tag{7}$$

Lobbying function

$$\begin{aligned} grant_{it} &= \gamma_i + \gamma_t + \gamma_{\text{INV}} inv_{it} + \gamma_{\hat{q}} \widehat{q}_{it} + \gamma_{q_{80}} q_{i,80} + \gamma_g g_{i,t-1} \\ &\quad + \gamma_{\text{NFIRMS}} NFIRMS_{it} + \gamma_{\text{PARTISAN}} PARTISAN \\ &\quad + \gamma_{\text{MINING}} DMINING_i + \nu_{2it}, \end{aligned} \tag{8}$$

Investment function

$$\begin{aligned} inv_{it} &= \beta_i + \beta_t + \beta_{\text{GRANT}} grant_{it} + \beta_{\hat{q}} \widehat{q}_{it} + \beta_{q_{80}} q_{i,80} \\ &\quad + \beta_g g_{i,t-1} + \beta_{\text{PROD}} \alpha_G q_{it} / g_{i,t-1} + \beta_{\text{DEBT}} debt_{it} \\ &\quad + \beta_{\text{TAX}} tax_{it} + \beta_{\text{CARS}} CARS_{it} + \beta_{\text{MINING}} DMINING_i + \nu_{3it}, \end{aligned} \tag{9}$$

where we assume that ν_{kit}, $k = 1, 2, 3$, are i.i.d. variables with mean zero and variance σ_i. Note, that variables with names in lower case are divided by the labour input L.

We include a dummy variable $DMINING$ to all equations indicating whether or not the mining industry is present in city i. Equation (7) refers to the production function of the manufacturing sector in city i at time t. Equation (8) describes the infrastructure investment grants which city i receives, whereas equation (9) refers to the autonomous infrastructure investments undertaken by city i.

From the Cobb-Douglas production function, marginal productivity of infrastructure capital is defined as $\partial Q_{it}/\partial G_{it} = \alpha_G Q_{it}/G_{it}$. We included this measure of the expected productivity effects of infrastructure both in the 'lobbying' and the 'investment' function. Since g_{it} also contains current investment inv_{it}, we replaced it with its lagged value $g_{i,t-1}$.

Our estimation strategy is as follows: first, we estimate a 'Between' regression. Thus, for each city observations for the years 1980, 1986 and 1988 are averaged. Then, we estimate a two-way fixed-effects ('Within') Panel data model, where dummy variables for cities and years are included. Finally, a restricted version of the previous model is estimated, where instead of the whole set of 81 city dummy variables only a set of 8 'Bundesland' dummy variables is included. The usual rank and order conditions for the identification of the parameters in the simultaneous system of equations are satisfied.

Table IV shows the results of the 'Between' regression. The estimates of the 'Between' regression can be interpreted as 'long-run' parameters. Furthermore, the 'Between' analysis is appealing in our context since we are interested in the allocation *across* cities, and this cross-sectional variation is captured by the 'Between' variance.

The number of observations for this model is 87. In order to compare the results for different estimators, the simultaneous system (7)-(9) was estimated with (1) non-linear OLS, (2) non-linear 2SLS, (3) non-linear 3SLS, and (4) with non-linear Full-Information Maximum Likelihood (FIML). Dummy variables for 'Bundesländer' (denoted 'BuLa') have been also included.

It is worth noting that for all 3 equations the fit of regression is remarkably good. We performed White's (1980) test for heteroscedasticity, which because of its generality is also a test for misspecification of the model. None of the tests is significant at a 10 percent level, thus the null hypothesis of homoscedasticity is not rejected. The condition numbers are between 82 und 94. Except for the

Table IV. Empirical results for 'Between' regression

Nonlinear	**OLS**		**2SLS**		**3SLS**		**FIML**	
Production function: $\ln q_{it}$								
α_i	BuLa-effects**		BuLa-effects**		BuLa-effects**		BuLa-effects***	
α_K	0.668	(7.78)	0.691	(7.93)	0.685	(7.87)	0.658	(8.26)
α_G	0.130	(1.70)	0.082	(1.00)	0.086	(1.04)	0.130	(1.82)
$\tilde{\alpha}_L$	0.033	(0.79)	0.020	(0.47)	0.023	(0.55)	0.039	(1.02)
α_{MINING}	-0.474	(-4.61)	-0.484	(-4.68)	-0.483	(-4.68)	-0.474	(-4.94)
White $\chi^2(39)$	19.0		18.42		18.52		19.17	
R^2	0.667		0.665		0.665		0.667	
Lobbying function: $grant_{it}$								
γ_i	BuLa-effects*		BuLa-effects		BuLa-effects		BuLa-effects*	
γ_{inv}	0.162	(2.44)	0.118	(0.68)	0.111	(0.64)	0.157	(1.01)
$\gamma_{\hat{q}}$	-0.733	(-2.78)	-0.799	(-2.62)	-0.809	(-2.66)	-0.729	(-3.27)
$\gamma_{q_{80}}$	-0.006	(-2.28)	-0.008	(-2.06)	-0.008	(-2.14)	-0.006	(-3.17)
γ_G	0.011	(4.55)	0.013	(2.68)	0.013	(2.75)	0.011	(2.54)
γ_{PROD}	1.616	(0.97)	3.919	(0.74)	3.891	(0.78)	1.586	(1.15)
γ_{PARTISAN}	0.025	(3.18)	0.026	(3.04)	0.026	(3.03)	0.025	(3.57)
γ_{NFIRMS}	0.001	(0.52)	0.001	(0.48)	0.001	(0.62)	0.001	(0.56)
γ_{DMINING}	0.289	(1.39)	0.256	(1.03)	0.253	(1.02)	0.285	(1.26)
White $\chi^2(85)$	86.82		86.78		86.77		86.82	
R^2	0.756		0.753		0.753		0.756	
Investment function: inv_{it}								
β_i	BuLa-effects***		BuLa-effects**		BuLa-effects**		BuLa-effects***	
β_{grant}	0.373	(2.09)	-0.221	(-0.40)	-0.173	(-0.31)	0.029	(0.06)
$\beta_{\hat{q}}$	0.210	(0.46)	0.056	(0.10)	0.034	(0.06)	-0.023	(-0.05)
$\beta_{q_{80}}$	-0.001	(-0.23)	-0.001	(-0.14)	-0.003	(-0.39)	-0.005	(-1.21)
β_G	0.028	(6.47)	0.034	(4.16)	0.034	(4.19)	0.033	(4.37)
β_{PROD}	-1.170	(-0.51)	-4.507	(-0.62)	-3.698	(-0.57)	-1.324	(-0.68)
β_{DEBT}	-0.055	(-3.26)	-0.057	(-3.07)	-0.057	(-3.08)	-0.056	(-3.62)
β_{TAX}	0.013	(0.60)	0.015	(0.63)	0.011	(0.48)	0.015	(0.77)
β_{CAR}	3.032	(1.02)	4.092	(1.23)	4.112	(1.26)	3.544	(1.28)
β_{DMINING}	-1.022	(-3.11)	-0.764	(-1.78)	-0.811	(-1.9)	-0.926	(-2.51)
White $\chi^2(86)$	87.0		87.0		87.0		87.0	
R^2	0.834		0.806		0.810		0.823	
Condition-Number	82.36		88.34		94.05		89.53	
Obs.	87		87		87		87	

t-values are given in parentheses. * at 10 %, ** at 5 %, *** at 1 % significant.
Hausman test statistic 2SLS vs. OLS: 1.484 (χ^2), 45 df.

Table V. Correlation of equation residuals from OLS estimation, table IV

Corr	$\ln q_{it}$	$grant_{it}$	inv_{it}
$\ln q_{it}$	1.0000	0.0882	-0.0001
$grant_{it}$	0.0882	1.0000	-0.2261
inv_{it}	-0.0001	-0.2261	1.0000

parameters of endogenous variables (α_G, γ_{inv}, γ_{PROD}, β_{grant}, β_{PROD}), parameter estimates turn out to be fairly robust with respect to the applied estimation methodologies (OLS, 2SLS, 3SLS, FIML). The correlations of equation residuals from OLS estimation are presented in table V. These correlations are relatively low, indicating that there will not be much gain in efficiency from the system estimation methods 3SLS and FIML compared to OLS.

We also performed a Hausman test on the difference of estimates between OLS and 2SLS estimation. This test statistic is 1.484 with 45 degrees of freedom, which implies that estimates of OLS and 2SLS do not differ significantly. Hence, due to lower variance of OLS compared to instrumental variable techniques the former is the preferred estimation method.

The estimate for private capital is significant at a 1 percent level for all estimations. In contrast to this, the estimate for infrastructure capital is only significant at a 10 percent level for OLS and FIML estimation. Constant returns to scale are not rejected for all estimations, which can be concluded from the insignificance of $\tilde{\alpha}_L$. The dummy variable $DMINING$, indicating whether the mining industry is present in city or not, is highly significant with a negative coefficient. Thus, expected output of the manufacturing sector in cities with mining is lower than in cities without a mining industry. The 'Bundesländer' dummy variables are significant. Hence, expected output of cities' manufacturing sectors are different depending on the 'Bundesland' in which they are located.

Turning to the lobbying function, we find for OLS estimation that the level of (autonomous) investment γ_{inv} is positively related to the level of grants which city i receives. Thus, grants and investment appear to be *complementary* to each other, i.e., there is no indication of a substitution effect of grants on investment. Furthermore, we find that the lower a city's initial income q_{80} and the lower its growth rate $\widehat{q}$ of the manufacturing sector in the period 1980-88, the higher is the expected level of grants a city receives. Hence, policy considerations of higher level governments to promote growth in 'poorer' cities or cities with poor economic performance seem to be evident.

On the other hand, expected productivity effects (γ_{PROD}) of infrastructure investment appear not to matter for the allocation of investment grants. One explanation for this finding is given by Seidel and Vesper (1999). They state that investment grant decisions from the federal government are based on consensus between *all* states, so that '[...] this approach is prone to produce decisions that carefully skirt all areas of conflict. In terms of economic efficiency, the solution will often seem less than optimal, as there can be no guarantee that the money is being put to its most productive use.'

Furthermore, the higher the infrastructure stock of the city (γ_G), the higher the expected level of grants it receives. Since the 'Länder' dummy variables are significant at a 10 percent level, there is some evidence that there is a systematic difference between the level of grants cities in the various 'Bundesländer' receive.

Lobbying activities of manufacturing firms, as indicated by the coefficient for the number of firms ($NFIRMS$), do not appear to be important for infrastructure investment grant decisions. However, the estimate for the partisan variable ($PARTISAN$) is significant, which means that the expected level of grants is higher if the local city council and the state ('Bundesland') government share the same political affiliation. We interpret this finding as an indication that short-cutting of the bargaining process between cities and the federal states governments by means of vertical political alignments is indeed important.

Turning to the investment function, from the significance and the positive sign of β_{grant} in the OLS estimation we conclude, again, that grants and investments are complementary. In contrast to the lobbying function, policy variables, such as the initial income q_{80} or the growth rate $\widehat{q}$, are not significant predictors for expected investment level of city i. Also, the expected return from infrastructure investments, β_{PROD}, is not significant. However, we find that the higher the level of $DEBT$, the lower the city's infrastructure spending, which is a very plausible finding. This corroborates our initial assumption that the financial room for manoeuvre is decisive for local infrastructure investments. On the other hand, trade tax income of a city β_{TAX} is not significant for its investment decisions. Expected investments are lower in cities where the mining industry is present. Finally, the coefficient for the number of cars (β_{CAR}) is not a significant determinant for investment decisions.

Table VI presents the results for the 'Within' (fixed-effects) regression. This regression is based on the full sample of 261 observations having non-missing values. Here we have included dummies both for cities as well as for time periods. Note first that for this model it is not possible to include the variables $q_{i,80}$, $\widehat{q}_{it}$ and $DMINING_i$ because these are constant for each city i and hence would be perfect collinear with the fixed-effects for cities if included.

It turns out that the city effects are highly significant for all equations, whereas the time-effects are only significant for the production and investment function. The fit of the production function is fairly high (R^2 is about 0.95) but the estimated coefficients are not plausible, except that for private capital (α_K). The high condition number of 2148 indicates that for this model the degree of collinearity might cause estimation problems. This is due to the high correlation of the fixed effects with some of the variables (see also Ai and Cassou, 1997). This is particularly true for variables which do not vary much (i.e. have not enough 'Within' variation) over the 3 sample years 1980, 1986, and 1988, e.g. the infrastructure stock G. In fact, the estimation of the parameter α_G is adversely affected by this multicollinearity.

A preferred estimation strategy is therefore to impose some restrictions on the parameters in order to reduce the degree of collinearity. Table VII gives the results for a restricted regression. It is again based on 261 observations as in table VI. However, in table VII we have included 'Bundesländer' dummy variables instead of the city dummy variables. One can construct the 9 'Bundesländer' dummies from the 87 city dummy variables using 72 restrictions.

Note first, that as expected the condition number for the 'restricted' regression is lower than that of the 'Within' regression. However, testing the imposed restrictions with a Wald test it turns out that these are rejected on a 1 percent level. In our case therefore we have to deal with a trade-off between a potential estimation bias by imposing 'false' restrictions on the one hand and reducing collinearity and thereby gaining precision of estimates on the other hand.

Table VI. Empirical results for 'Within' (panel) regression

	Nonlinear	OLS
Production function: $\ln q_{it}$		
α_i	city-effects***	
α_t	time-effects***	
α_K	0.309	(3.25)
α_G	1.310	(1.71)
$\tilde{\alpha}_L$	1.264	(1.63)
R^2	0.945	
Lobbying function: $grant_{it}$		
γ_i	city-effects***	
γ_t	time-effects	
γ_{inv}	0.106	(2.40)
γ_G	0.001	(0.10)
γ_{PROD}	-0.215	(-0.99)
γ_{PARTISAN}	-0.027	(-1.88)
γ_{NFIRMS}	0.003	(0.76)
R^2	0.765	
Investment function: inv_{it}		
β_i	city-effects***	
β_t	time-effects***	
β_{grant}	0.305	(2.31)
β_G	-0.021	(-1.90)
β_{PROD}	0.507	(1.20)
β_{DEBT}	-0.038	(-1.14)
β_{TAX}	0.030	(0.38)
β_{CAR}	3.908	(0.75)
R^2	0.831	
Condition-Number	2148	
Obs.	261	

t-values are given in parentheses
* significant at 10 percent
** significant at 5 percent
***significant at 1 percent

Table VII. Empirical results for restricted (Panel) regression

Nonlinear	OLS		2SLS		3SLS		FIML	
Production function: $\ln q_{it}$								
α_i	BuLa-effects***		BuLa-effects***		BuLa-effects***		BuLa-effects***	
α_t	time-effects		time-effects		time-effects		time-effects	
α_K	0.594	(10.84)	0.594	(10.84)	0.594	(10.97)	0.577	(11.01)
α_G	0.195	(3.91)	0.195	(3.90)	0.194	(3.91)	0.200	(4.13)
$\tilde{\alpha}_L$	0.051	(1.88)	0.050	(1.87)	0.056	(2.11)	0.057	(2.21)
White $\chi^2(56)$	67.73		67.71		68.0		69.3	
R^2	0.578		0.578		0.578		0.578	
Lobbying function: $grant_{it}$								
γ_i	BuLa-effects*		BuLa-effects*		BuLa-effects***		BuLa-effects	
γ_t	time-effects		time-effects		time-effects***		time-effects	
γ_{inv}	0.155	(4.63)	0.211	(5.07)	0.376	(9.87)	0.146	(1.16)
γ_G	0.008	(5.92)	0.006	(4.47)	0.003	(1.85)	0.008	(2.83)
γ_{PROD}	-0.894	(-1.78)	-0.856	(-1.64)	-0.50	(-1.02)	-0.234	(-0.40)
γ_{PARTISAN}	0.022	(3.83)	0.023	(4.01)	0.017	(3.26)	0.019	(3.29)
γ_{NFIRMS}	0.001	(-0.25)	0.001	(-0.10)	0.001	(0.17)	0.001	(0.27)
White $\chi^2(83)$	141.1***		140.4***		147.2***		140.3***	
R^2	0.517		0.511		0.421		0.511	
Investment function: inv_{it}								
β_i	BuLa-effects***		BuLa-effects***		BuLa-effects***		BuLa-effects	
β_t	time-effects***		time-effects***		time-effects***		time-effects***	
β_{grant}	0.446	(4.11)	0.652	(4.59)	1.238	(9.65)	-0.573	(-0.88)
β_G	0.025	(7.60)	0.023	(6.54)	0.014	(4.46)	0.035	(4.24)
β_{PROD}	0.235	(0.29)	0.006	(0.01)	-0.371	(-0.44)	-2.528	(-1.89)
β_{DEBT}	-0.043	(-2.89)	-0.044	(-2.96)	-0.035	(-2.64)	-0.046	(-2.85)
β_{TAX}	0.034	(1.78)	0.036	(1.88)	0.027	(1.57)	0.028	(1.36)
β_{CAR}	6.961	(2.95)	6.731	(2.82)	4.969	(2.34)	7.948	(3.03)
White $\chi^2(98)$	134.5***		136.4***		151.7***		156.9***	
R^2	0.619		0.613		0.527		0.490	
Condition-Number	61.5		61.7		74.5		75.4	
Obs.	261		261		261		261	

t-values are given in parentheses. * at 10 %, ** at 5 %, *** at 1 % significant.
Hausman test statistic 2SLS vs. OLS: 16.22 (χ^2), 44 df.

Table VIII. Correlation of equation residuals from OLS estimation, table VII

Corr	$\ln q_{it}$	$grant_{it}$	inv_{it}
$\ln q_{it}$	1.0000	0.1428	-0.0952
$grant_{it}$	0.1428	1.0000	-0.2454
inv_{it}	-0.0952	-0.2454	1.0000

With the restricted regression, like a 'pooled' regression, we capture both the 'Within' and the 'Between' variance. We can establish several main results from table VII. First, we find that public capital is significant in the production function for all estimations, i.e. the public capital expenditure of cities is productive. Second, it turns out that autonomous investment by cities and grants from higher level governments are complementary. Third, it appears that if the majority of the city council's allegiance is the same as the political affiliation of the 'Bundesland' government, the expected level of grants a city receives is higher. Fourth, tax income has a positive effect on investment decisions, while the level of debts of a given city has a negative impact. Fifth, the number of cars in a city also turns out to be a significant determinant for infrastructure investment decisions. Sixth and finally, in contrast to the findings from Cadot et al. (1999) for France, we do not find evidence that the number of manufacturing firms in a given city has an influence on infrastructure investment decisions. Thus, the crucial findings of the 'Between' regression also hold for the restricted 'Within' model.

The reported Hausman test statistic again favours the null hypothesis of no simultaneity between infrastructure capital and output. Hence, feedback effects from output on infrastructure via the investment equation appear to be weak.

5. Conclusions

In this study we estimated a system of equations comprising of a production function, an infrastructure investment function and an investment grant function using a panel data set of large German cities. Several key empirical findings emerge from these estimates. First, we find that the public capital expenditure of the cities in our sample are productive, i.e. public infrastructure is positively linked with output of cities' manufacturing sectors. Second, it appears that infrastructure investment and investment grants are complementary, i.e., there is no evidence of a crowding out or substitutional effect from grants to cities autonomous investment. Third, we find evidence that it is easier for a city to obtain investment grants if the city council has the same political affiliation as the higher-tier 'Bundesland' (state) government. Therefore, the allocation of grants may depart substantially from an allocation that would be efficient and socially optimal.

On the other hand, we do not find evidence that the number of manufacturing firms is a significant determinant for the allocation of grants. This finding is in contrast to a previous study on French regions by Cadot et al. (1999). One potential explanation for this is that in France the politically and socially highly centralized system makes it easy for large firms to intervene in politics. The hierarchy in administration mostly prevents the establishment of several autonomous sub-levels in the decision making process.

The German case diverges from France in several aspects: overlapping responsibilities of governments, diluted accountability, mixed financing, and vertical and horizontal coordination (Scharpf, 1999), which we summarized in this study as 'intertwined politics'. Our empirical estimations show that in those cases where the local council members share the same political affiliation, they perform better in attracting investment grants. Thus, political lobbying takes place but only between different governmental levels. Because of the peculiar nature of the bargaining process there is not much room for political lobbying by large firms.

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Notes

[1] These grants or subsidies from higher levels are called 'Finanzzuweisungen' (financial assignments). One major example in the infrastructure context is municipality transport infrastructure funds ('GVFG') that were created to promote transport infrastructure investment.

[2] This is not to say that in Germany powerful lobbying is not possible. It just adopts a different form. Individual firms which are having difficulties in lobbying for their own interests in a distribution game still can unite to increase the overall investment budget. Therefore, organizations like the German Federation of Industries (BDI) participate vitally in infrastructure affairs. It is the typical form of interest representation in 'corporatist' democracies (Lehmbruch, 1984).

[3] We assume that w_i includes both consumers' and producers' welfare.

[4] Original title: 'Statistisches Jahrbuch der Städte und Gemeinden'.

[5] This includes also the mining industries.

[6] 'Volkswirtschaftliche Gesamtrechnung der Länder, Bruttowertschöpfung der kreisfreien Städte, der Landkreise und der Arbeitsmarktregionen in der Bundesrepublik Deutschland', Heft 26, Statistisches Landesamt Baden-Württemberg, 1995.

[7] For further details, see Deitmar (1993).

[8] We would like to thank Helmut Seitz for kindly providing us with these data.

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